

## **Appendix H**

**Emissions from WAG 5 Remediation Activities: ARA-02,  
ARA-07, ARA-08, ARA-13, ARA-16, ARA-21, and ARA-25**

## **Appendix H**

### **Emissions from Remediation Activities WAG 5: ARA-02, ARA-07, ARA-08, ARA-13, ARA-16, ARA-21 and ARA-25**

The assumptions and calculations used to estimate air emissions of particulates and radionuclides that could result from planned remediation activities at the Auxiliary Reactor Area (ARA) are presented herein. These calculations are intended to satisfy the requirements of 40 CFR 61.92 and 61.94(a) NESHAPS for Emissions of Radionuclides Other than Radon from DOE Facilities and the IDAPA 16.01.01.585 and .586 Toxic Substances.

Table H-1 summarizes the sites and selected remedy (or remedy options) for the ARA sites addressed in the WAG 5 RD/RA Phase 1 Work Plan. The table includes a listing of contaminated media (known or potential) to be generated by the remediation, the estimated volume of contaminated media (Attachment H1), and the contaminants of concern (COCs). This information is based on the site descriptions presented in Section 3.2 of the Work Plan (Physical Site Description) and the description of the nature and extent of contamination presented in the ROD (DOE-2000a).

Three of the site remedies and substantiating alternative analyses were presented in the ROD (DOE-ID 2000). These sites (ARA-02, ARA-16, and ARA-25), present the greatest potential to produce radionuclide emissions because of the known radionuclide contamination present. However, not all components of these systems to be remediated are contaminated. For example, and as discussed in the ROD (DOE-ID 2000a), the only contaminated waste associated with ARA-02 is the dried seepage pit sludge. As a result the sludge represents the only principal source for radionuclide emissions. With respect to ARA-16, soil surrounding the tank vault is potentially contaminated, presumably from spills related to previous waste transfer activities from the radionuclide tank. However, the gravel pack in the concrete vault encompassing the tank has been sampled and is likely not contaminated above the remediation goals. Additionally, the proposed removal of the ARA-16 tank contents by jetting or vacuum will preclude generating particulate or radionuclide emissions. ARA-25 soils have been incorporated into the remediation for logistical purposes.

The other four sites (ARA-07, ARA-08, ARA-13, and ARA-21) are inactive waste systems and, as presented in the Work Plan, may or may not present the potential to generate radionuclide emissions. Contaminants of concern for these sites will be determined during remediation activities as described in the Work Plan and Field Sampling Plan (DOE-ID 2000b).

Contaminated material volumes and air emissions of particulates, radionuclides, and nonradionuclides from the planned remediation activities are presented in the following tables. Where analytical data are available and represent a potential emission source, the particulate emission estimates were then used to estimate the emissions and release values. For radionuclides, the release, in curies, is used as input to the CAP88PC Model, an EPA-approved computer code. CAP88PC calculates the radionuclide dose to a receptor at the nearest site boundary and nearest community. At present, quantitative analytical data for the radionuclide contaminants of concern are only available for sites ARA-02, ARA-16, and ARA-25. As a result, the CAP88PC Model was only executed for these sites. The outputs are included as Attachment H2.

**Table H-1. Summary of the selected remedies.**

Sites	Selected Remedy	Contaminated (known or potential) material to be excavated or removed representing an emission source	Estimated volume of contaminated material to be removed	Radionuclide contaminants of concern
ARA-02 Sanitary Waste System	Removal and off-Site disposal.	Seepage Pit Sludge (dry) Gravel at the base of the Seepage Pit Pumice Blocks Gravel between the Mainline and the Seepage Pit (potential) Soil (potential) Mainline pipeline sludge (potential)	38 yd <sup>3</sup>	Cs-137 Ra-226 U-235 U-238 Aroclor-1242 Lead
ARA-16 Radionuclide Tank (Two Options), including the ARA-25 Soils	<u>Option 1</u> Removal of the ARA-16 Radionuclide Tank and contents intact. Removal of sectioned associated piping. Ship for off-Site ex situ thermal treatment and disposal. Excavation of the concrete vault and disposal at an approved facility based on sampling results. <u>Option 2</u> Removal of the ARA-16 Radionuclide Tank contents for shipment to an off-Site facility for thermal treatment and disposal. Decontamination and excavation of the tank and associated piping and disposal at the RWMC. Excavation of the concrete vault and disposal at an approved facility based on sampling results.	Gravel surrounding the tank (potential) Concrete Vault (potential) Soil outside of the vault Soil associated with ARA-25	234 yd <sup>3</sup>	Cs-137 for soil; Ra-226 Arsenic Lead To be determined during remediation
ARA-07 Seepage Pit to East	Removal and disposal of wooden cover and above-ground blocks at an approved on-Site facility. Removal and recycling of chain-link fencing. Backfill pit with earthen materials.	If removed: Seepage Pit Gravel Base/Sludge Pumice Blocks	60 yd <sup>3</sup>	To be determined during remediation
ARA-08 Seepage Pit to West	Removal and disposal of concrete slabs at an approved on-Site facility. Backfill pit with earthen materials.	If removed: Seepage Pit Gravel Base/Sludge Pumice Blocks Overburden (potentially contaminated)	80 yd <sup>3</sup>	To be determined during remediation

**Table H-1. (continued).**

Sites	Selected Remedy	Contaminated (known or potential) material to be excavated or removed representing an emission source	Estimated volume of contaminated material to be removed	Radionuclide contaminants of concern
ARA-13 Sanitary Sewer Leach Field and Septic Tank	<p>Sampling of tank, manhole, and distribution box contents.</p> <p>Based on sampling results, either</p> <p>a) Removal and disposal of manhole, septic tank, distribution box, and contents at an approved off-Site facility, or</p> <p>b) Abandonment of all components in place.</p> <p>Note: Work Plan drawings show removal of components.</p>	<p>Manhole</p> <p>Septic Tank Sludge</p> <p>Distribution Box</p> <p>Overburden (potentially contaminated)</p>	66 yd <sup>3</sup>	To be determined during remediation
ARA-21 Test Area IV Septic Tank and Leach Pit No. 2	<p>Sampling of tank and chlorine contact tank contents.</p> <p>Based on sampling results, either</p> <p>a) Removal and disposal of tank, chlorine contact tank, and contents at an approved off-Site facility, and abandon the seepage pit in place, or</p> <p>b) Abandonment of all components in place.</p> <p>Note: Work Plan drawings show removal of components.</p>	<p>Geographic boundary of potential contamination to be defined during remediation</p>	<p>Geographic boundary of potential contamination to be defined during remediation</p>	To be determined during remediation

**Table H-2.** Volume estimate for ARA-02.

Contaminated Material to be Removed	Dimension	Volume ft <sup>3</sup>	Volume yd <sup>3</sup>	Weight lbs	Weight Tons
Seepage Pit Sludge	9ft diameter base; 0.5 ft of sludge	40.5	38.4	99072	50
Gravel at Base	9ft diameter base; 1 ft of gravel	81			
Gravel between mainline/pit	9ft diameter; 1.3 ft of gravel	105			
Pumice Block Pit Construction	9 ft diameter; 10 ft deep	810			
Soil (Potential)	—	—	—	—	—
Pipeline Sludge (Potential)	—	—	—	—	—

**Table H-3.** Particulate/Radionuclide Emission Calculations.

	PM <sub>30</sub>	PM <sub>15</sub>	PM <sub>10</sub>	PM <sub>5</sub>	PM <sub>2.5</sub>
Particulate Emission Estimates					
1. Emission Factors (lbs/ton)	9.7E-04	6.3E-04	4.5E-04	2.6E-04	1.4E-04
2. Tons of contaminated material to be moved	50	50	50	50	50
3. Amount of Material Moved per hour (ton/hr)	61.92	61.92	61.92	61.92	61.92
4. Time to remove contaminated material (hrs)	1	1	1	1	1
5. Emission Rates (lbs/hr)	4.8E-02	3.1E-02	2.3E-02	1.3E-02	7.1E-03
6. Particulate Emissions (lbs)	4.8E-02	3.1E-02	2.3E-02	1.3E-02	7.1E-03
Radionuclide Emission Calculations					
Cs-137 Activity (pCi/g)	178	178	178	178	178
Cs-137 Activity (Ci/lb)	8.07E-08	8.07E-08	8.07E-08	8.07E-08	8.07E-08
Ra-226 Activity (pCi/g)	89.6	89.6	89.6	89.6	89.6
Ra-226 Activity (Ci/lb)	4.06E-08	4.06E-08	4.06E-08	4.06E-08	4.06E-08
U-235 Activity (pCi/g)	120	120	120	120	120
U-235 Activity (Ci/lb)	5.44E-08	5.44E-08	5.44E-08	5.44E-08	5.44E-08
U-238 Activity (pCi/g)	190	190	190	190	190
U-238 Activity (Ci/lb)	8.62E-08	8.62E-08	8.62E-08	8.62E-08	8.62E-08
Release Calculations (CAPP88PC Input)					
Cs-137 Release (Ci)	3.29E-09				
Ra-226 Release (Ci)	1.66E-09				
U-235 Release (Ci)	2.22E-09				
U-238 Release (Ci)	3.52E-09				
Nonradinuclide Emission Calculations					
Aroclor-1242 (lbs/hr)	8.4E-07				
Lead (lbs/hr)	3.7E-05				
PM <sub>x</sub> = particulate matter, x microns or less in diameter					
Emissions (Line 6) = Time to Remove (Line 4) X Emission Rates (Line 5)					

**Table H-5.** Volume estimate for ARA-16.

Contaminated Material to be Removed	Dimension	Volume ft <sup>3</sup>	Volume yd <sup>3</sup>	Weight lbs	Weight tons
Soil/Gravel/Concrete Vault (Simulated Source volume from ROD)	20 x 22 x 10 ft	4400	234	603900	302
Soil associated with ARA-25	16 x 24 x 5	1920			
Sludge (4.5 gallons) and liquid (312 gallons) in the ARA-16 Radionuclide Tank are to be removed by jetting and pumping and/or vacuum extraction therefore pose minimal emission source.					

**Table H-6.** Particulate/Radionuclide Emission Calculations.

		PM <sub>30</sub>	PM <sub>15</sub>	PM <sub>10</sub>	PM <sub>5</sub>	PM <sub>2.5</sub>
Particulate Emission Estimates						
1. Emission Factors (lbs/ton)	9.7E-04	6.3E-04	4.5E-04	2.6E-04	1.4E-04	
2. Tons of contaminated material to be moved	302	302	302	302	302	
3. Amount of Material Moved per hour (ton/hr)	61.92	61.92	61.92	61.92	61.92	
4. Time to remove contaminated material (hrs)	4.9	4.9	4.9	4.9	4.9	
5. Emission Rates (lbs/hr)	6.0E-02	3.9E-2	2.8E-02	1.6E-02	8.9E-03	
6. Particulate Emissions (lbs)	2.9E-01	1.9E-01	1.4E-01	7.9E-02	4.4E-02	
Radionuclide Emission Calculations						
Cs-137 Activity (pCi/g)	449	449	449	449	449	
Cs-137 Activity (Ci/lb)	2.0E-07	2.0E-07	2.0E-07	2.0E-07	2.0E-07	
Ra-226 Activity (pCi/g)	1600	1600	1600	1600	1600	
Ra-226 Activity (pCi/lb)	7.26E-07	7.26E-07	7.26E-07	7.26E-07	7.26E-07	
Release Calculations (CAPP88PC Input)						
Cs-137 Release (Ci)	2.8E-07					
Ra-226 Release (Ci)	1.0E-07					
Nonradionuclide Emission Calculations						
Arsenic (lbs/hr)	1.82E-06					
Lead (lbs/hr)	5.21E-05					
PM <sub>x</sub> = particulate matter, x microns or less in diameter						
Emissions (Line 6) = Time to Remove (Line 4) X Emission Rates (Line 5)						

**Table H-8.** Volume estimate for ARA-07.

Contaminated Material to be Removed	Dimension	Volume ft <sup>3</sup>	Volume yd <sup>3</sup>	Weight lbs	Weight tons
Seepage Pit	13 ft diameter 10 ft height	1327	60	154495	77
Gravel at Base/Sludge	13 ft diameter base; 1 ft of gravel/sludge	133			
Pumice Block Pit Construction	13 ft diameter; 10 ft deep	157			

**Table H-9.** Particulate/Radionuclide Emission Calculations.

	PM <sub>30</sub>	PM <sub>15</sub>	PM <sub>10</sub>	PM <sub>5</sub>	PM <sub>2.5</sub>
<b>Particulate Emission Estimates</b>					
1. Emission Factors (lbs/ton)	9.7E-04	6.3E-04	4.5E-04	2.6E-04	1.4E-04
2. Tons of contaminated material to be moved	60	60	60	60	60
3. Amount of Material Moved per hour (ton/hr)	61.92	61.92	61.92	61.92	61.92
4. Time to remove contaminated material (hrs)	1.24	1.24	1.24	1.24	1.24
5. Emission Rates (lbs/hr)	6.8E-02	4.4E-02	3.2E-02	1.8E-02	1.0E-03
6. Particulate Emissions (lbs)	8.4E-02	5.4E-02	4.0E-02	2.3E-02	1.2E-02
<b>Radionuclide Emission Calculations</b>					
Samples to be collected during remediation	—	—	—	—	—
<b>Release Calculations (CAPP88PC Input)</b>					
NA					
PM <sub>x</sub> = particulate matter, x microns or less in diameter Emissions (Line 6) = Time to Remove (Line 4) X Emission Rates (Line 5)					

**Table H-10.** Volume estimate for ARA-08.

Contaminated Material to be Removed	Dimension	Volume ft <sup>3</sup>	Volume yd <sup>3</sup>	Weight lbs	Weight tons
Seepage Pit	13 ft diameter 10 ft height	1327	80	205202	103
Gravel at Base/Sludge	13 ft diameter base; 2 ft of gravel/sludge	265			
Overburden	13 ft diameter; 3 ft of gravel	398			
Pumice Block Pit Construction	13 ft diameter; 10 ft deep	157			

**Table H-11.** Particulate/Radionuclide Emission Calculations.

	PM <sub>30</sub>	PM <sub>15</sub>	PM <sub>10</sub>	PM <sub>5</sub>	PM <sub>2.5</sub>
<b>Particulate Emission Estimates</b>					
1. Emission Factors (lbs/ton)	9.7E-04	6.3E-04	4.5E-04	2.6E-04	1.4E-04
2. Tons of contaminated material to be moved	80	80	80	80	80
3. Amount of Material Moved per hour (ton/hr)	61.92	61.92	61.92	61.92	61.92
4. Time to remove contaminated material (hrs)	1.65	1.65	1.65	1.65	1.65
5. Emission Rates (lbs/hr)	9.2E-02	6.0E-02	4.4E-02	2.3E-02	1.4E-02
6. Particulate Emissions (lbs)	1.54E-01	9.8E-02	7.2E-02	4.1E-02	2.2E-02
<b>Radionuclide Emission Calculations</b>					
Samples to be collected during remediation	—	—	—	—	—
<b>Release Calculations (CAPP88PC Input)</b>					
NA					
PM <sub>x</sub> = particulate matter, x microns or less in diameter					
Emissions (Line 6) = Time to Remove (Line 4) X Emission Rates (Line 5)					



**Table H-12.** Volume estimate for ARA-13.

Contaminated Material to be Removed	Dimension	Volume ft <sup>3</sup>	Volume yd <sup>3</sup>	Weight lbs	Weight tons
Manhole	5 ft diameter 4 ft height	78	66	170208	85
Septic Tank	23 x 6 x 6 ft	828			
Distribution Box	9 x 3.25 x 9 ft	263			
Overburden	23 x 6 x 5 ft	1781			

**Table H-13.** Particulate/Radionuclide Emission Calculations.

	PM <sub>30</sub>	PM <sub>15</sub>	PM <sub>10</sub>	PM <sub>5</sub>	PM <sub>2.5</sub>
<b>Particulate Emission Estimates</b>					
1. Emission Factors (lbs/ton)	9.7E-04	6.3E-04	4.5E-04	2.6E-04	1.4E-04
2. Tons of contaminated material to be moved	66	66	66	66	66
3. Amount of Material Moved per hour (ton/hr)	61.92	61.92	61.92	61.92	61.92
4. Time to remove contaminated material (hrs)	1.43	1.43	1.43	1.43	1.43
5. Emission Rates (lbs/hr)	3.6E-03	2.4E-03	1.7E-03	9.8E-04	5.4E-04
6. Particulate Emissions (lbs)	5.2E-03	3.4E-03	2.4E-03	1.4E-03	7.7E-04
<b>Radionuclide Emission Calculations</b>					
Samples to be collected during remediation	—	—	—	—	—
<b>Release Calculations (CAPP88PC Input)</b>					
NA					
PM <sub>x</sub> = particulate matter, x microns or less in diameter					
Emissions (Line 6) = Time to Remove (Line 4) X Emission Rates (Line 5)					

Releases of particulates and radionuclides during remediation activities are projected only to occur from airborne emissions during pickup and dropping of contaminated material during excavation. Particulate emission factors and rates were calculated for this release mechanism for particulate material using the assumptions detailed in Attachment H1.

The total emissions (in lbs) were calculated by multiplying the emission rates by the time it takes to remove all of the contaminated material. The amount of material to be moved per hour (61.92 ton/hr) was estimated for TAN TSF-06, Area B Site remediation and assumed to be appropriate for use herein. The estimate was calculated by taking the amount of material transported per dump truck load (12 yd<sup>3</sup>) multiplied by 4 loads per hour and the weight of soil per yd<sup>3</sup> (1.29 ton/yd<sup>3</sup>). The time to excavate the contaminated volume was estimated by dividing the total weight of the material by the amount of material to be moved per hour.

Assuming that the radionuclide contamination is homogeneously distributed throughout the contaminated media and will be released with particulates, radionuclide activity released (in Ci) was calculated by multiplying the particulate emissions by the radionuclide soil concentrations in (Ci/lb).

The radionuclide releases for the PM30 particulate size were the highest calculated and therefore used as input to the CAPP88PC model. Exposures were estimated for two locations: the nearest public access location at Highway 20 approximately 800 m from the ARA I facility and at Atomic City, the closest community (6200 m).

For ARA-02, the total effective does equivalent rates generated by the model were a maximum rate of 4.7E-07 mrem/year to an individual at the site boundary and 5.8E-08 mrem/ year at the closest community. For ARA-16/ARA-25, the total effective does equivalent rates generated by the model were a maximum rate of 2.2E-09 mrem/year to an individual at the site boundary and 1.3E-09 mrem/ year at the closest community. These doses are estimated to be received by an individual over an entire year. However, because the emissions of radionuclides from the remediation are over a much shorter period of time, the dose is considered overestimated. The estimated dose is below the NESHAPS limit of 10 mrem/year. The CAP88PC output is included as Attachment H2.

Nonradionuclide emission calculations were performed by estimating the lb/hr emissions for each COC, using the contaminant concentrations as provided in DOE (2000a). The emission estimates were then compared to Screening Emission Levels presented in IDAPA 16.01.01. Aroclor-1242 and lead did not exceed the screening levels (6.6E-05 and 7E-03 [as tetraethyl lead] lbs/hr, respectively). Arsenic was slightly in excess of the screening level of 1.5E-06 lbs/hr; however, the estimates take no credit for dust suppression and considered overestimates. Dust suppression techniques will be used to minimize the generation of fugitive dust emissions.

## References

DOE-ID 2000a. Power Burst Facility and Auxiliary Reactor Area Record of Decision, DOE/ID-10700, January.

DOE-ID 2000b. Field Sampling Plan for the WAG 5 Remedial Action - Phase I, DOE/ID-10758, Rev. A, April.



**ATTACHMENT H1**  
**Emission Calculation Method**



# Attachment H1

## Emission Calculation Method

Methods to estimate the fugitive particulate matter (PM) generated from the aggregate handling and storage piles from Reference 1, Chapter 13 were used to estimate dust emissions from remedial activities at WAG 5. The PM<sub>30</sub>, PM<sub>15</sub>, PM<sub>10</sub>, PM<sub>5</sub>, and PM<sub>2.5</sub> distributions were calculated.

The calculations are for particulate emissions from pickup and dropping of soil during Excavation/Loading. To estimate the quantity of size specific PM emissions generated, an emission factor for each size of PM was calculated using an equation and the associated particle size multipliers from Reference 1, Section 13.2.4, Aggregate Handling and Storage Piles. The equation and definition of terms are as follows:

$$E_f = k(0.0032)[(U/5)^{1.3} / (M/2)^{1.4}]$$

Where:

- $E_f$  = emission factor (lbs/ton)
- $k$  = particle size multiplier (dimensionless from Reference 1, Section 13.2.4)
- $U$  = mean wind speed, (8.2 mph)
- $M$  = soil moisture content (6%)

The emission factors calculated were then used to estimate emission rates for dust generated during excavation due to pickup and dropping of material as follows:

$$E = E_f T_m$$

Where:

- $E$  = particulate emission rate (lbs/hr)
- $E_f$  = emission factor (lbs/ton)
- $T_m$  = Tons of material moved per hour (ton/hr)

The particulate emission (lbs/ton) were estimated as follows:

- PM<sub>30</sub> = 0.0009694
- PM<sub>15</sub> = 0.0006288
- PM<sub>10</sub> = 0.0004585
- PM<sub>5</sub> = 0.000262
- PM<sub>2.5</sub> = 0.0001441

## Reference

Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, volume I Stationary Point and Area Sources, January 1995.



## **ATTACHMENT H2**





C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

D O S E   A N D   R I S K   E Q U I V A L E N T   S U M M A R I E S

Non-Radon Individual Assessment

Apr 21, 2000 01:21 pm

Facility: ARA-02

Address:

City:

State: ID

Zip:

Source Category:

Source Type: Area

Emission Year: 2000

Comments:

Dataset Name: ara02

Dataset Date: Apr 21, 2000 12:23 pm

Wind File: C:\CAP88PC2\WNDFILES\24156.WND

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	2.93E-08
BREAST	3.25E-08
R MAR	8.54E-08
LUNGS	1.60E-05
THYROID	2.90E-08
ENDOST	9.06E-07
RMNDR	7.09E-08
EFFEC	1.99E-06

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	4.55E-08
INHALATION	1.93E-06
AIR IMMERSION	5.92E-13
GROUND SURFACE	1.68E-08
INTERNAL	1.98E-06
EXTERNAL	1.68E-08
TOTAL	1.99E-06

Apr 21, 2000 01:21 pm

SUMMARY  
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NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
CS-137	2.86E-09
RA-226	5.30E-08
U-235	7.77E-07
U-238	1.16E-06
TOTAL	1.99E-06

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	1.28E-13
BONE	5.13E-14
THYROID	1.12E-14
BREAST	1.10E-13
LUNG	2.63E-11
STOMACH	5.73E-14
BOWEL	3.38E-14
LIVER	6.30E-14
PANCREAS	3.96E-14
URINARY	1.23E-13
OTHER	4.84E-14
TOTAL	2.69E-11

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	2.95E-13
INHALATION	2.63E-11
AIR IMMERSION	1.38E-17
GROUND SURFACE	3.91E-13
INTERNAL	2.65E-11
EXTERNAL	3.91E-13
TOTAL	2.69E-11

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
CS-137	7.49E-14
RA-226	9.81E-13
U-235	1.05E-11
U-238	1.54E-11
TOTAL	2.69E-11

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)  
(All Radionuclides and Pathways)

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	Distance (m)			
Direction	400	800	3100	6200
N	1.7E-06	8.0E-07	1.3E-07	6.6E-08
NNW	4.2E-07	2.4E-07	5.7E-08	4.1E-08
NW	3.4E-07	2.1E-07	5.4E-08	4.0E-08
WNW	4.0E-07	2.3E-07	5.6E-08	4.1E-08
W	7.1E-07	3.7E-07	7.4E-08	4.7E-08
WSW	7.4E-07	3.6E-07	7.1E-08	4.6E-08
SW	8.8E-07	4.1E-07	7.7E-08	4.8E-08
SSW	7.5E-07	3.5E-07	6.9E-08	4.5E-08
S	1.0E-06	4.7E-07	8.4E-08	5.0E-08
SSE	6.8E-07	3.3E-07	6.8E-08	4.5E-08
SE	6.2E-07	3.1E-07	6.5E-08	4.4E-08
ESE	6.0E-07	2.8E-07	6.2E-08	4.2E-08
E	1.0E-06	4.4E-07	7.9E-08	4.8E-08
ENE	1.2E-06	5.1E-07	8.7E-08	5.1E-08
NE	1.5E-06	6.5E-07	1.0E-07	5.8E-08
NNE	2.0E-06	9.2E-07	1.4E-07	7.0E-08

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INDIVIDUAL LIFETIME RISK (deaths)  
(All Radionuclides and Pathways)

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Distance (m)				
Direction	400	800	3100	6200
N	2.3E-11	1.1E-11	1.5E-12	6.7E-13
NNW	5.5E-12	3.0E-12	5.6E-13	3.4E-13
NW	4.4E-12	2.6E-12	5.2E-13	3.2E-13
WNW	5.3E-12	2.9E-12	5.5E-13	3.3E-13
W	9.4E-12	4.9E-12	7.8E-13	4.2E-13
WSW	9.9E-12	4.6E-12	7.4E-13	4.0E-13
SW	1.2E-11	5.4E-12	8.3E-13	4.3E-13
SSW	1.0E-11	4.5E-12	7.2E-13	3.9E-13
S	1.4E-11	6.2E-12	9.3E-13	4.6E-13
SSE	9.1E-12	4.3E-12	7.0E-13	3.9E-13
SE	8.3E-12	4.0E-12	6.7E-13	3.7E-13
ESE	7.9E-12	3.7E-12	6.2E-13	3.5E-13
E	1.4E-11	5.8E-12	8.5E-13	4.4E-13
ENE	1.7E-11	6.7E-12	9.6E-13	4.8E-13
NE	2.1E-11	8.7E-12	1.2E-12	5.7E-13
NNE	2.7E-11	1.2E-11	1.7E-12	7.4E-13

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C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

D O S E   A N D   R I S K   E Q U I V A L E N T   S U M M A R I E S

Non-Radon Individual Assessment

Apr 21, 2000 01:33 pm

Facility: ARA-16

Address:

City:

State: ID                      Zip:

Source Category:

Source Type: Area

Emission Year: 2000

Comments:

Dataset Name: ARA16

Dataset Date: Apr 21, 2000 12:29 pm

Wind File: C:\CAP88PC2\WNDFILES\24156.WND

## ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	6.03E-10
BREAST	6.27E-10
R MAR	2.22E-09
LUNGS	8.65E-09
THYROID	6.38E-10
ENDOST	2.28E-08
RMNDR	6.98E-10
EFFEC	2.46E-09

## PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	1.24E-09
INHALATION	1.20E-09
AIR IMMERSION	5.57E-16
GROUND SURFACE	2.47E-11
INTERNAL	2.44E-09
EXTERNAL	2.47E-11
TOTAL	2.46E-09

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
CS-137	2.51E-10
RA-226	2.21E-09
U-235	0.00E+00
U-238	0.00E+00
TOTAL	2.46E-09

## CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	2.83E-15
BONE	1.22E-15
THYROID	1.96E-16
BREAST	1.63E-15
LUNG	2.72E-14
STOMACH	1.09E-15
BOWEL	5.92E-16
LIVER	1.37E-15
PANCREAS	9.31E-16
URINARY	5.36E-16
OTHER	1.14E-15
TOTAL	3.87E-14

## PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	1.14E-14
INHALATION	2.68E-14
AIR IMMERSION	1.30E-20
GROUND SURFACE	5.77E-16
INTERNAL	3.81E-14
EXTERNAL	5.77E-16
TOTAL	3.87E-14

Apr 21, 2000 01:33 pm

SUMMARY  
Page 4

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
CS-137	6.56E-15
RA-226	3.22E-14
U-235	0.00E+00
U-238	0.00E+00
TOTAL	3.87E-14

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)  
(All Radionuclides and Pathways)

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	Distance (m)			
Direction	400	800	3100	6200
N	1.6E-09	2.1E-09	1.8E-09	1.4E-09
NNW	1.3E-09	1.3E-09	1.2E-09	1.1E-09
NW	1.3E-09	1.2E-09	1.2E-09	1.1E-09
WNW	1.4E-09	1.3E-09	1.2E-09	1.1E-09
W	1.7E-09	1.6E-09	1.3E-09	1.2E-09
WSW	1.8E-09	1.8E-09	1.3E-09	1.2E-09
SW	2.0E-09	2.0E-09	1.4E-09	1.2E-09
SSW	1.9E-09	1.9E-09	1.4E-09	1.2E-09
S	2.4E-09	2.2E-09	1.5E-09	1.3E-09
SSE	1.9E-09	1.8E-09	1.3E-09	1.2E-09
SE	2.0E-09	1.8E-09	1.3E-09	1.2E-09
ESE	2.2E-09	1.9E-09	1.3E-09	1.2E-09
E	2.5E-09	2.4E-09	1.5E-09	1.3E-09
ENE	2.0E-09	2.4E-09	1.6E-09	1.3E-09
NE	1.8E-09	2.3E-09	1.7E-09	1.4E-09
NNE	1.7E-09	2.3E-09	1.9E-09	1.5E-09

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INDIVIDUAL LIFETIME RISK (deaths)  
(All Radionuclides and Pathways)

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Distance (m)				
Direction	400	800	3100	6200
N	2.0E-14	3.1E-14	2.5E-14	1.8E-14
NNW	1.5E-14	1.5E-14	1.3E-14	1.2E-14
NW	1.5E-14	1.4E-14	1.2E-14	1.1E-14
WNW	1.7E-14	1.6E-14	1.3E-14	1.2E-14
W	2.3E-14	2.2E-14	1.5E-14	1.3E-14
WSW	2.5E-14	2.4E-14	1.6E-14	1.3E-14
SW	2.9E-14	2.9E-14	1.7E-14	1.4E-14
SSW	2.7E-14	2.8E-14	1.6E-14	1.3E-14
S	3.7E-14	3.4E-14	1.8E-14	1.4E-14
SSE	2.8E-14	2.5E-14	1.5E-14	1.3E-14
SE	2.9E-14	2.5E-14	1.5E-14	1.3E-14
ESE	3.3E-14	2.8E-14	1.5E-14	1.2E-14
E	3.9E-14	3.8E-14	1.9E-14	1.4E-14
ENE	2.9E-14	3.7E-14	2.2E-14	1.6E-14
NE	2.4E-14	3.5E-14	2.4E-14	1.7E-14
NNE	2.3E-14	3.5E-14	2.8E-14	1.9E-14

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